# Infestation of insect pests in tree-rice agroforestry system

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**Abstract** The prevalence of insect pests was studied on rice BR11 (mukta) as understory crop grown in association with 11 years old selected tree species viz, Akashmoni, Jhau and Albida in the field laboratory of the Department of Agroforestry, Bangladesh Agricultural University (BAU), Mymensingh during the period from July to December, 2003. Among the three species Albida and Jhau possessed the largest canopy and there light penetration rate were high. On the other hand, Akashmoni had the lowest canopy but it penetrated low amount of light. Albida-rice association showed the lowest infestation of major rice insects followed by Jhau-rice association, while Akashmoni-rice association showed the highest insect infestation. Light intensity in the control plot (absent of tree species) was maximum and it caused minimum severity of insects infestation as compared to other associations. From the result it appeared that light interception has the relationship with insect population in rice. Therefore, tree species having sparse canopy which allowed easy penetration of sunlight is suitable for tree-rice agroforestry system.

**Keywords:** Light interception, Insect infestation; Rice, Agroforestry.
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## Introduction

Agroforestry is a production technique or method that combines agriculture and forestry on same piece of land to fully utilize the natural resources of sunlight, water and nutrition. Cropland agroforestry is one of the most important and widely used practices where trees are grown in and around the crop field. Cropland agroforestry is not a traditional practice except in a few places of north-western part of Bangladesh, where tree species like Date palm, Babla, Khoir, and Palmyra palm grow naturally on agricultural lands in the higher parts of the Ganges flood plain and are intentionally retained and maintained by the farmers for different house hold utilities and products and also for earning money (Abedin and Quddus 1991).

Cropland agroforestry includes trees that are cultivated along with various annual crops like paddy, wheat and other cash crops in farmers land. In this country farming is mostly subsistence and crop based. Rice is the principal crop covering about 80% of the total cropped land of the country Trees are simultaneously planted in rows, sparsely in crop field and/or along the ails (boundary lines). The continuous rice cropping has created favorable condition for certain kinds of insect pests. Moreover, the prevailing warm and humid conditions have favored rapid multiplication of insect pests and diseases. The estimated annual loss of rice in Bangladesh due to insect pest and diseases amounts about 1.5 to 2.0 million tons (Siddique 1992). So far 175 species of insects have been recorded as rice pests (BRRI 1985). Of these 20-30 species are economically important. The rice hispa, stem borers, plant hoppers and rice ear cutting caterpillar cause serious damage to rice crop each year. Major insect pests cause about 13% yield losses to Boro, 24% to Aus and 18% to Aman crops (Miah and Karim 1984).

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As the practices of simultaneous cultivation of rice along with inter-cropping of suitable tree species is gaining popularity, the prevalence of major insects is necessary to determine. Keeping this view in mind, the present research has been undertaken to determine the prevalence of major insect pests of rice grown in association with three selected tree species.

## Materials and methods

The experiment was conducted at the Field Laboratory, Department of Agroforestry, Bangladesh Agricultural University, Mymensingh during July–December 2003. The experiment was carried out in RCBD with three replications using the recommended rate of fertilizers for rice. The treatment combinations were $T_o$ = Without tree × Rice association; $T_1$ = Akashmoni × Rice association; $T_2$ = Jhau × Rice association and $T_3$ = Albida × Rice association. *Acacia auriculiformis* (Akashmoni), *Casuarina equisetifolia* (Jhau) and *Acacia albida* (Albida) all the tree species were 11 years old and rice was used as understory crop. The crown diameter of each of the 3 trees measured along North-South and East-West axis using a measuring tape. Four rice plots each of 0.75m×1.0m were laid around a tree. Forty days old seedlings of BR-11 were collected and two/three seedlings per hill were planted in all the plots including control. To estimate the insect infestation the sampling was done by means of a square sampler (0.5 m x 0.5m) made up of jute sticks. During sampling the sampler was placed on the emerged rice plants inside the field. The number of infested tillers, leaves and spikelets were counted, following the method outlined by Dyck and Hsieh (1972). The infestation percentage was calculated using the formula = A/B × 100, where, A=Number of infested tillers or spikelets or leaves and B= Number of total tillers or spikelets or leaves. The estimation of insect infested tillers, leaves and spikelets in the rice fields was carried out at different stages then average mean of four stages was taken. Light intensity in each of the tree-rice associations was measured with the help of "Quantum Sensor". Light was measured above the canopy of each tree-rice association by different orientation as per design and treatment. Three readings were taken from each ori

entation as well as in control plot and the values were averaged. The collected data were computed and analyzed following the appropriate design of the experiment. Duncan's multiple range test (DMRT) was done to show the significant differences among the treatments.

## Results and discussions

Ten different species of rice pests' viz-cutworm, stem borer, plant hopper, grass hopper, case worm, leaf roller, skipper, gall midge, rice bug and earcutting caterpillar were observed at different tree-rice association. Out of three tree-rice association, $T_3$ (Albida-rice) association showed in lowest insect infestation of all major insects and $T_1$ (Akashmoni-rice) showed the highest insect infestation followed by $T_2$ (Jhau-rice) association (Table 1).

**Cutworm (*Agrotis spp.*):** The young caterpillars and the mature larvae cut down the host plant at base and feed on the plant. Out of the three tree-rice associations the highest infestation rate of cutworm (8.5%) was found in $T_2$ (Jhau-rice) association followed by Albida-rice ($T_3$) (7.1%). However, no infestation rate was found in the control (open field, $T_0$).

**Table 1. Percent plant parts damaged due to infestation of different rice pests.**

| Tree-Rice association | Cut worm | Stem borer | Plant hopper | Case worm | Leaf roller | Grass hopper | Skipper | Gall midge | Rice bug | Ear cutting caterpillar |
|---|---|---|---|---|---|---|---|---|---|---|
| **$T_0$** (Control) | 0.00 b | 2.05 b | 0.00 | 1.4 b | 0.63 b | 2.62 b | 3.44 | 0.00 | 4.72 c | 0.00 b |
| **$T_1$** (A.moni- rice) | 0.00 b | 10.63 a | 2.80 | 4.5 a | 8.84 a | 7.44 a | 8.60 | 2.73 | 8.90a | 6.90 a |
| **$T_2$** (Jhau-rice) | 8.50 a | 2.74 b | 1.50 | 3.9 a | 6.90 a | 6.16 a | 4.80 | 0.78 | 8.10 ab | 6.65 a |
| **$T_3$** (Albida-rice) | 7.10 a | 3.25 b | 0.00 | 1.4 b | 3.10 b | 5.0 ab | 3.60 | 1.20 | 5.90 | 1.20 b |

* In a column, the figures having different alphabets are significantly different at 5% level of probability.

**Stem borer *(Scirpophaga incertulas):*** Rice borers feed in the leaf sheath for about a week causing broad long tunnel. Whitish discolouration at feeding sites can be found and larvae bore into the stem. While feeding inside the stem the borer cuts off the growing points of the plant from the base resulting either "dead heart" (DH) or "white head" (WH) symptom during the tillering and flowering stages respectively. Among the three tree-rice association, $T_1$ (Akashmoni-rice) association showed significantly highest infestation rate (10.63%) and the lowest infestation (2.05%) was found in the control $T_o$. Similar report on stem borer infestation in agroforestry system has been reported by Jha (1995).

**Plant hopper *(Nilaparvata lugens):*** Plant hopper sucks juice from the leaves and stem. It is serious pest in agroforestry system. Plant hopper reduces number of tiller plant height, crop vigour, grain weight and increases unfilled grain. Plant hopper infestation did not show any statistical differences among the different tree-rice associations.

**Case worm *(Nymphulla depunctalis) :***In case of case worm, freshly hatched larvae feed on the surface of the tender leaves but later instars feed on the surface of the older leaves. Damaged portion characteristics by ladder like appearance by remove the leaf tissues. Out of the three tree-rice associations the highest caseworm infestation rate (4.5%) was found in $T_1$ (Akashmoni-rice) and the lowest infestation was (1.4%) found in $T_3$ (Albida-rice) association, which was similar with the control $T_0$.

**Leaf roller *(Cnaphalocrocis medinalis)***

Larvae of leaf roller remove the leaf tissues, fold a leaf blade together and glue it with silk stand. In case of leaf roller infestation, the highest infestation rate was found in $T_1$ (Akashmoni-rice) association (8.84%) and the lowest infestation rate (0.63%) of leaf was found in the control $T_0$. Pathak and Khan (1994) reported that shade condition favours the leaf roller development.

**Grass hopper *(Euscyrtus concinnus):*** It is a minor pest, both the nymphs and adults feed on rice leaves and the nurseries suffer the most when infestation becomes severe. The adult feed at the base of the maturing ear-heads causing them to dry up. Among the three tree-rice associations the highest grass hopper infestation rate was found in $T_1$ (Akashmoni-rice) association and the lowest rate in $T_3$ (Albida-rice) association which were respectively 4.62 % and 2.38 % higher from the control. Similar result was found by Amatobi *et al*., (1988).

**Skipper *(Pornata guttata):*** Skipper is a sporadic pest and feed on rice leaves by scraping the epidermal leaf tissue. Among the three tree-rice associations $T_1$ (Akashmoni-rice) association showed the highest infestation rate which was 8.65% and $T_3$ (Albida-rice) showed, the lowest infestation rate 3.6%. There was no significant difference among the three tree-rice associations.

**Gall midge *(Orseolia oryzae ):*** No significant differences were observed in the infestation of gall midge in the three tree-rice associations. It is a minor pest of rice. Van Vreden and Ahmadzabidi (1986) reported that the agroforestry system reduced the incidence of gall midge.

**Rice bug *(Leptocorisa* spp.*) :***Both the adults and nymphs insert their needlelike mouth parts between the lemma and paleas of the rice hill to suck the endosperm of rice grain. In order to feed, they secret a liquid to form a stylet sheath that hardened around the point of feeding and holds the mouthparts in place. Out of the three tree-rice associations, rice bug infestation was found highest in $T_1$ (Akashmoni-rice) association and the lowest was found in $T_3$ (Albida-rice) association which were 4.15% and 1.15% higher from the control.

**Ear cutting caterpillar *(Mythimna separata):*** Caterpillar cutting off leaf tips, leaf margins, panicles from the base. Among the three tree-rice association the highest infestation rate of panicle was found in $T_1$ (Akashmoni-rice) and the lowest was found in $T_3$ (Albida) which were 6.7% and 1.2 % higher form the control. Ear cutting caterpillar was a serious pest in agroforestry system reported by Litistinger and Catinding (1989).

Out of three tree-rice association $T_2$ (Jhau- rice) association possessed the largest canopy having 32.69$m^{-2}$ followed by Albida 23.55$m^{-2}$ and Akashmoni had the lowest canopy 9.08$m^{-2}$ . In the present stands Albida rice association developed least incidence of major insects like stem borer, plant hopper, case worm, leaf roller, grass hopper, rice bug, skipper etc. Albida and Jhau possessed the largest canopy and there light intensity rate were high. On the other hand Akashmoni had the lowest canopy but there light intensity was very low. As a result, highest insect

infestation rate was recorded in Akashmoni rice association (Figure 1).

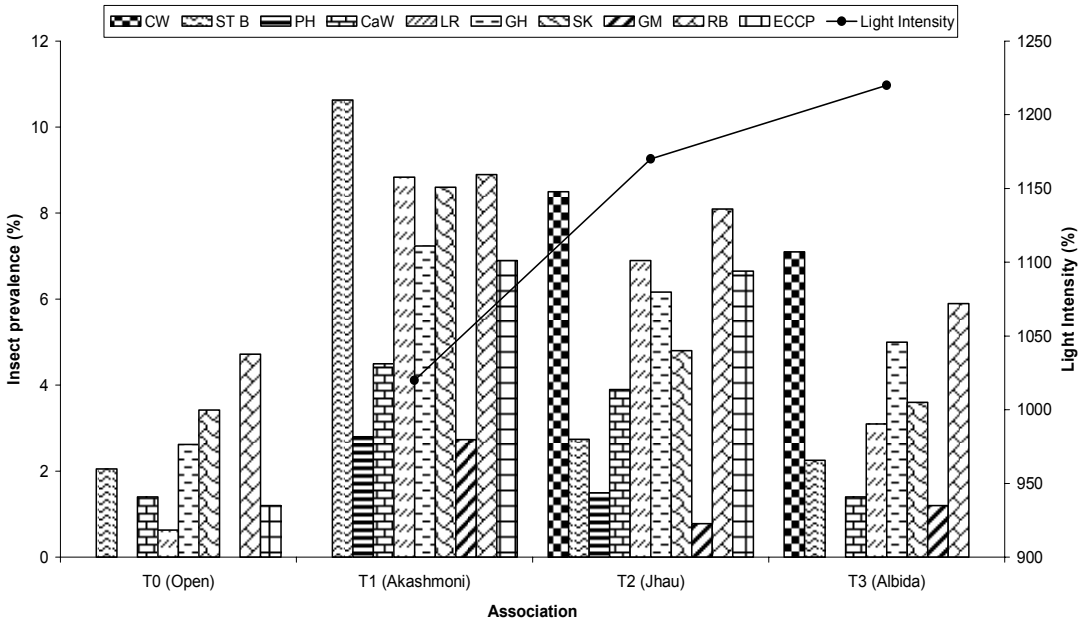


**Figure 1. Effect of light intensity on the prevalence of insect pests in different tree-rice associations.**

CW: Cut worm; STB: Stem borer; PH: Plant hopper; CaW: Case worm; LR: Leaf roller; GH: Grass hopper; SK: Skipper; GM: Gall midge; RB: Rice bug; ECCP: Ear cutting caterpillar

From the result it appeared that light interception has direct relationship with insect population in rice. Yet there is no research reports on tree-rice joint production system therefore this finding is the first report in this field. In agroforestry system tree creates the shade condition for the understory agricultural crop causing highest insect population and varied their feeding activity. The finding of this study is in agreement with those of Room and Smith, (1975), Risch, (1981) and Jaques, (1983). For successful cultivation of rice under tree canopy, the selection of tree species is, therefore, very important. Sparse canopy tree species like Albida which easily allowed penetration of sunlight is suitable for cropland agroforestry system.

## Conclusion

Now a day's application of insecticide is not preferred in modern Agroforestry and even in agriculture. For maintaining sound environment eco-friendly Integrated Pest Management should be adopted first. Even before that identification and their economic impact should be detected. In a model Agroforestry system selection of appropriate tree species association is very much important to secure optimum production along with the minimum health and environmental hazards. Tree species that provide minimum shade and create less support for pest can ensure the goals of agroforestry and make the people interested to practice tree- rice based agroforestry in their own fields.

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